

STARPOWER

SEMICONDUCTOR

IGBT

GD75PIL120C6S

1200V/75A PIM in one-package

General Description

STARPOWER IGBT Power Module provides ultra low conduction loss as well as short circuit ruggedness. They are designed for the applications such as general inverters and UPS.

Features

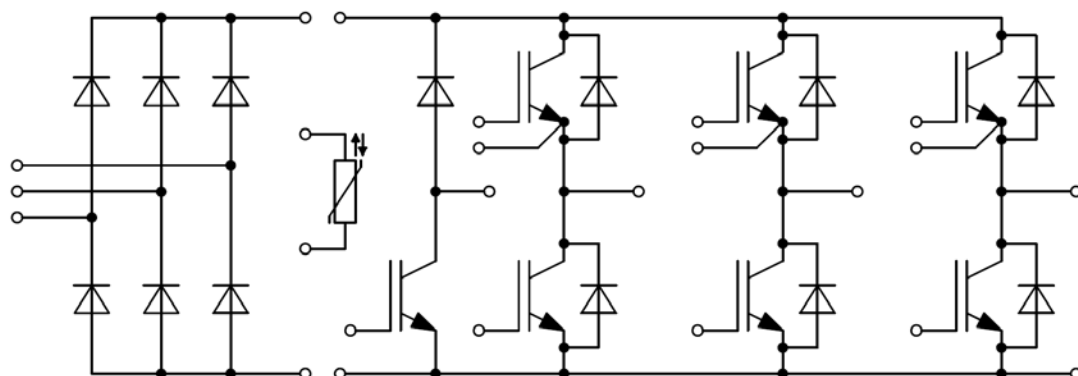
- Low $V_{CE(sat)}$ SPT+ IGBT technology
- 10 μ s short circuit capability
- $V_{CE(sat)}$ with positive temperature coefficient
- Maximum junction temperature 175 °C
- Low inductance case
- Fast & soft reverse recovery anti-parallel FWD
- Isolated copper baseplate using DBC technology



Typical Applications

- Inverter for motor drive
- AC and DC servo drive amplifier
- Uninterruptible power supply

Equivalent Circuit Schematic



Absolute Maximum Ratings $T_C=25^{\circ}\text{C}$ unless otherwise noted**IGBT-inverter**

Symbol	Description	Values	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 20	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	140 75	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	150	A
P_D	Maximum Power Dissipation @ $T_J=175^{\circ}\text{C}$	538	W

Diode-inverter

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	75	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	150	A

Diode-rectifier

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1600	V
I_O	Average Output Current @ $T_C=80^{\circ}\text{C}$	75	A
I_{FSM}	Surge Forward Current $V_R=0\text{V}, t_p=10\text{ms}, T_J=45^{\circ}\text{C}$	1100	A
I^2t	I^2t -value, $V_R=0\text{V}, t_p=10\text{ms}, T_J=45^{\circ}\text{C}$	6050	A^2s

IGBT-brake

Symbol	Description	Values	Unit
V_{CES}	Collector-Emitter Voltage	1200	V
V_{GES}	Gate-Emitter Voltage	± 30	V
I_C	Collector Current @ $T_C=25^{\circ}\text{C}$ @ $T_C=100^{\circ}\text{C}$	80 40	A
I_{CM}	Pulsed Collector Current $t_p=1\text{ms}$	80	A
P_D	Maximum Power Dissipation @ $T_J=175^{\circ}\text{C}$	337	W

Diode-brake

Symbol	Description	Values	Unit
V_{RRM}	Repetitive Peak Reverse Voltage	1200	V
I_F	Diode Continuous Forward Current	40	A
I_{FM}	Diode Maximum Forward Current $t_p=1\text{ms}$	80	A

Module

Symbol	Description	Values	Unit
T_{jmax}	Maximum Junction Temperature(inverter,brake) Maximum Junction Temperature (rectifier)	175 150	$^{\circ}\text{C}$
T_{jop}	Operating Junction Temperature	-40 to +150	$^{\circ}\text{C}$
T_{STG}	Storage Temperature Range	-40 to +125	$^{\circ}\text{C}$
V_{ISO}	Isolation Voltage RMS, $f=50\text{Hz}, t=1\text{min}$	4000	V
M	Mounting Torque, Screw M5	3.0 to 6.0	N.m

IGBT-inverter Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=75\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.90	2.35	V
		$I_C=75\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		2.10		
		$I_C=75\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		2.20		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=3.0\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.0	6.5	7.0	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_j=25^{\circ}\text{C}$			400	nA
R_{Gint}	Internal Gate Resistance			3.0		Ω
C_{ies}	Input Capacitance	$V_{CE}=25\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		5.52		nF
C_{res}	Reverse Transfer Capacitance			0.26		nF
Q_G	Gate Charge	$V_{GE}=-15\text{---}+15\text{V}$		0.78		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=75\text{A}, R_G=1.0\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		519		ns
t_r	Rise Time			103		ns
$t_{d(off)}$	Turn-Off Delay Time			492		ns
t_f	Fall Time			215		ns
E_{on}	Turn-On Switching Loss			9.76		mJ
E_{off}	Turn-Off Switching Loss			5.03		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=75\text{A}, R_G=1.0\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		519		ns
t_r	Rise Time			104		ns
$t_{d(off)}$	Turn-Off Delay Time			517		ns
t_f	Fall Time			344		ns
E_{on}	Turn-On Switching Loss			11.9		mJ
E_{off}	Turn-Off Switching Loss			7.01		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=75\text{A}, R_G=1.0\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		527		ns
t_r	Rise Time			105		ns
$t_{d(off)}$	Turn-Off Delay Time			527		ns
t_f	Fall Time			395		ns
E_{on}	Turn-On Switching Loss			13.5		mJ
E_{off}	Turn-Off Switching Loss			8.30		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		350		A

Diode-inverter Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	$I_C=75\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		1.80	2.25	V
		$I_C=75\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		1.85		
		$I_C=75\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.85		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=75\text{A}, R_G=1.0\Omega, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		3.7		μC
I_{RM}	Peak Reverse Recovery Current			42		A
E_{rec}	Reverse Recovery Energy			2.24		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=75\text{A}, R_G=1.0\Omega, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		13.6		μC
I_{RM}	Peak Reverse Recovery Current			64		A
E_{rec}	Reverse Recovery Energy			5.30		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=75\text{A}, R_G=1.0\Omega, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		15.9		μC
I_{RM}	Peak Reverse Recovery Current			69		A
E_{rec}	Reverse Recovery Energy			6.36		mJ

Diode-rectifier Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	$I_C=75\text{A}, T_j=150^{\circ}\text{C}$		1.08		V
I_R	Reverse Current	$T_j=150^{\circ}\text{C}, V_R=1600\text{V}$			2.0	mA

IGBT-brake Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
$V_{CE(sat)}$	Collector to Emitter Saturation Voltage	$I_C=40\text{A}, V_{GE}=15\text{V}, T_j=25^{\circ}\text{C}$		1.80	2.25	V
		$I_C=40\text{A}, V_{GE}=15\text{V}, T_j=125^{\circ}\text{C}$		2.00		
		$I_C=40\text{A}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}$		2.05		
$V_{GE(th)}$	Gate-Emitter Threshold Voltage	$I_C=2.4\text{mA}, V_{CE}=V_{GE}, T_j=25^{\circ}\text{C}$	5.0	6.1	7.5	V
I_{CES}	Collector Cut-Off Current	$V_{CE}=V_{CES}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$			1.0	mA
I_{GES}	Gate-Emitter Leakage Current	$V_{GE}=V_{GES}, V_{CE}=0\text{V}, T_j=25^{\circ}\text{C}$			400	nA
R_{Gint}	Internal Gate Resistance			/		Ω
C_{ies}	Input Capacitance	$V_{CE}=30\text{V}, f=1\text{MHz}, V_{GE}=0\text{V}$		6.24		nF
C_{res}	Reverse Transfer Capacitance			0.15		nF
Q_G	Gate Charge	$V_{GE}=15\text{V}$		0.23		μC
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=40\text{A}, R_G=24\Omega, V_{GE}=\pm 15\text{V}, T_j=25^{\circ}\text{C}$		370		ns
t_r	Rise Time			84		ns
$t_{d(off)}$	Turn-Off Delay Time			334		ns
t_f	Fall Time			276		ns
E_{on}	Turn-On Switching Loss			5.45		mJ
E_{off}	Turn-Off Switching Loss			2.21		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=40\text{A}, R_G=24\Omega, V_{GE}=\pm 15\text{V}, T_j=125^{\circ}\text{C}$		375		ns
t_r	Rise Time			87		ns
$t_{d(off)}$	Turn-Off Delay Time			350		ns
t_f	Fall Time			328		ns
E_{on}	Turn-On Switching Loss			6.05		mJ
E_{off}	Turn-Off Switching Loss			3.45		mJ
$t_{d(on)}$	Turn-On Delay Time	$V_{CC}=600\text{V}, I_C=40\text{A}, R_G=24\Omega, V_{GE}=\pm 15\text{V}, T_j=150^{\circ}\text{C}$		376		ns
t_r	Rise Time			92		ns
$t_{d(off)}$	Turn-Off Delay Time			350		ns
t_f	Fall Time			338		ns
E_{on}	Turn-On Switching Loss			6.30		mJ
E_{off}	Turn-Off Switching Loss			3.70		mJ
I_{SC}	SC Data	$t_p \leq 10\mu\text{s}, V_{GE}=15\text{V}, T_j=150^{\circ}\text{C}, V_{CC}=900\text{V}, V_{CEM} \leq 1200\text{V}$		500		A

Diode-brake Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
V_F	Diode Forward Voltage	$I_C=40\text{A}, V_{GE}=0\text{V}, T_j=25^{\circ}\text{C}$		2.10	2.55	V
		$I_C=40\text{A}, V_{GE}=0\text{V}, T_j=125^{\circ}\text{C}$		2.00		
		$I_C=40\text{A}, V_{GE}=0\text{V}, T_j=150^{\circ}\text{C}$		1.97		
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=40\text{A}, R_G=24\Omega, V_{GE}=-15\text{V}$ $T_j=25^{\circ}\text{C}$		2.5		μC
I_{RM}	Peak Reverse Recovery Current			22		A
E_{rec}	Reverse Recovery Energy			1.28		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=40\text{A}, R_G=24\Omega, V_{GE}=-15\text{V}$ $T_j=125^{\circ}\text{C}$		4.8		μC
I_{RM}	Peak Reverse Recovery Current			26		A
E_{rec}	Reverse Recovery Energy			2.40		mJ
Q_r	Recovered Charge	$V_R=600\text{V}, I_F=40\text{A}, R_G=24\Omega, V_{GE}=-15\text{V}$ $T_j=150^{\circ}\text{C}$		5.0		μC
I_{RM}	Peak Reverse Recovery Current			28		A
E_{rec}	Reverse Recovery Energy			2.50		mJ

NTC Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Units
R_{25}	Rated Resistance			5.0		$\text{k}\Omega$
$\Delta R/R$	Deviation of R_{100}	$T_C=100^{\circ}\text{C}, R_{100}=493.3\Omega$	-5		5	%
P_{25}	Power Dissipation				20.0	mW
$B_{25/50}$	B-value	$R_2=R_{25}\exp[B_{25/50}(1/T_2-1/(298.15\text{K}))]$		3375		K

Module Characteristics $T_C=25^{\circ}\text{C}$ unless otherwise noted

Symbol	Parameter	Min.	Typ.	Max.	Unit
L_{CE}	Stray Inductance		60		nH
$R_{CC'+EE'}$	Module Lead Resistance, Terminal to Chip @ $T_C=25^{\circ}\text{C}$		4.00 2.00		m Ω
$R_{\theta JC}$	Junction-to-Case (per IGBT-inverter) Junction-to-Case (per Diode-inverter) Junction-to-Case (per Diode-rectifier) Junction-to-Case (per IGBT-brake-chopper) Junction-to-Case (per Diode-brake-chopper)			0.279 0.494 0.548 0.445 0.967	K/W
$R_{\theta CS}$	Case-to-Sink (per IGBT-inverter) Case-to-Sink (per Diode-inverter) Case-to-Sink (per Diode-rectifier) Case-to-Sink (per IGBT-brake-chopper) Case-to-Sink (per Diode-brake-chopper)		0.120 0.213 0.236 0.192 0.417		K/W
$R_{\theta CS}$	Case-to-Sink		0.009		K/W
G	Weight of Module		300		g

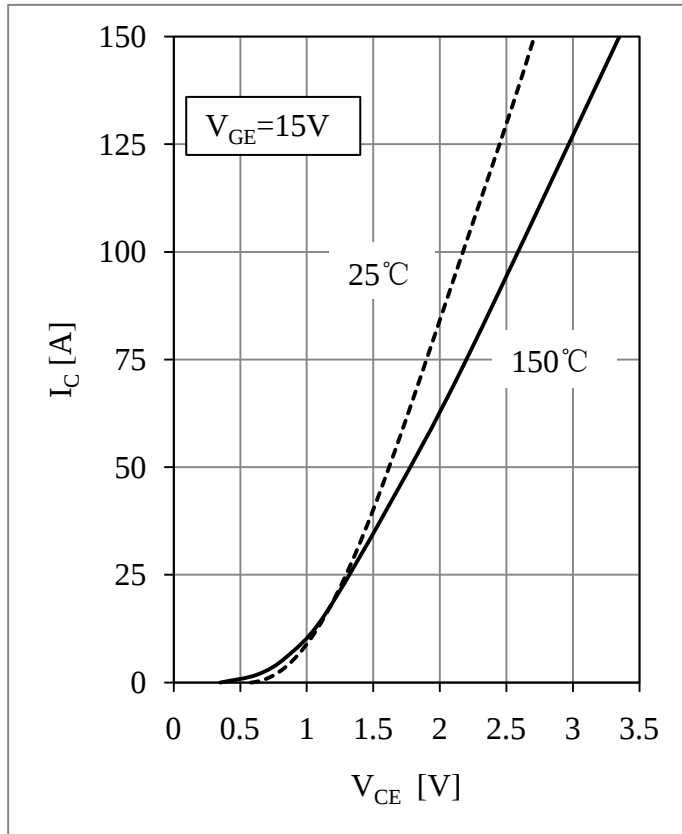


Fig 1. IGBT-inverter Output Characteristics

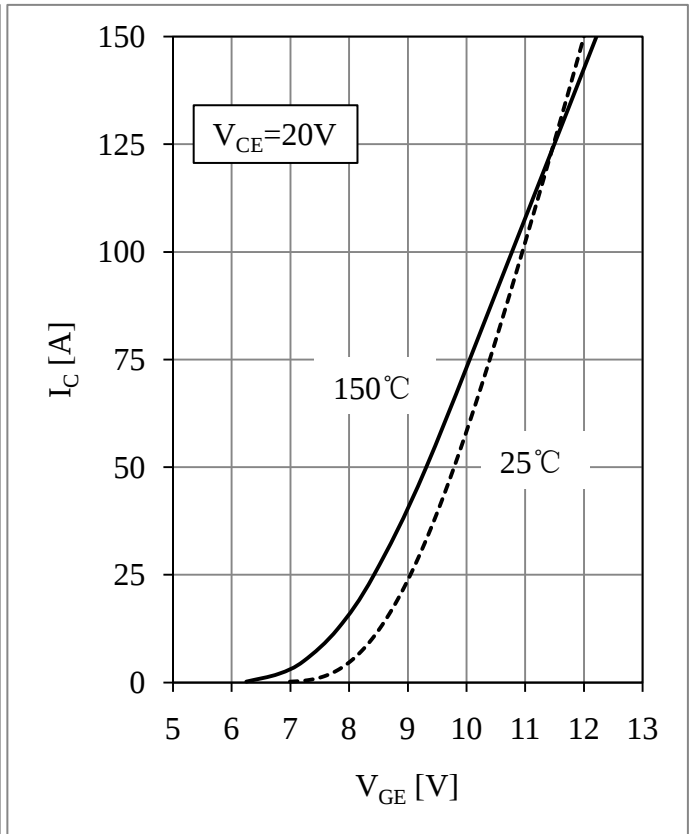
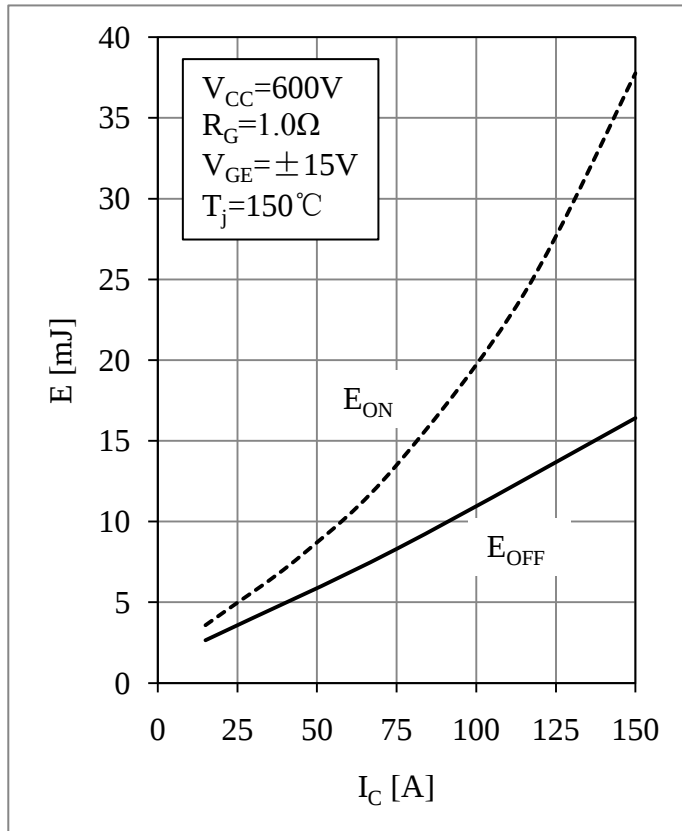
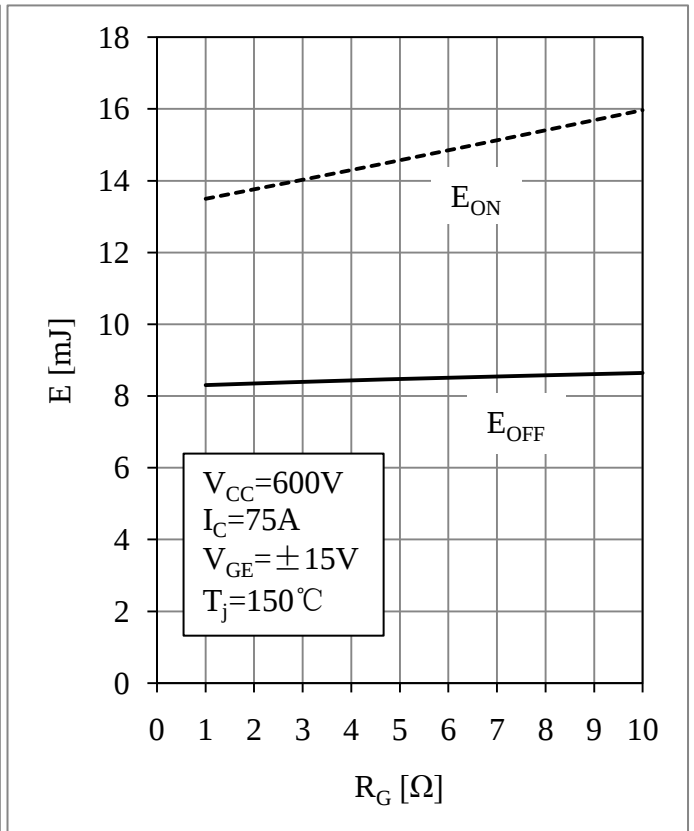


Fig 2. IGBT-inverter Transfer Characteristics

Fig 3. IGBT-inverter Switching Loss vs. I_C Fig 4. IGBT-inverter Switching Loss vs. R_G

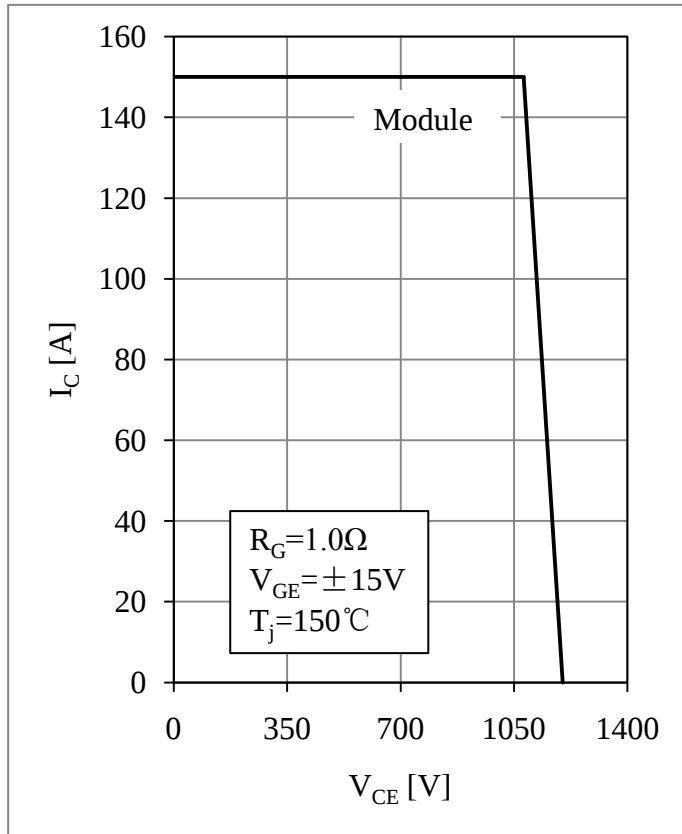


Fig 5. IGBT-inverter RBSOA

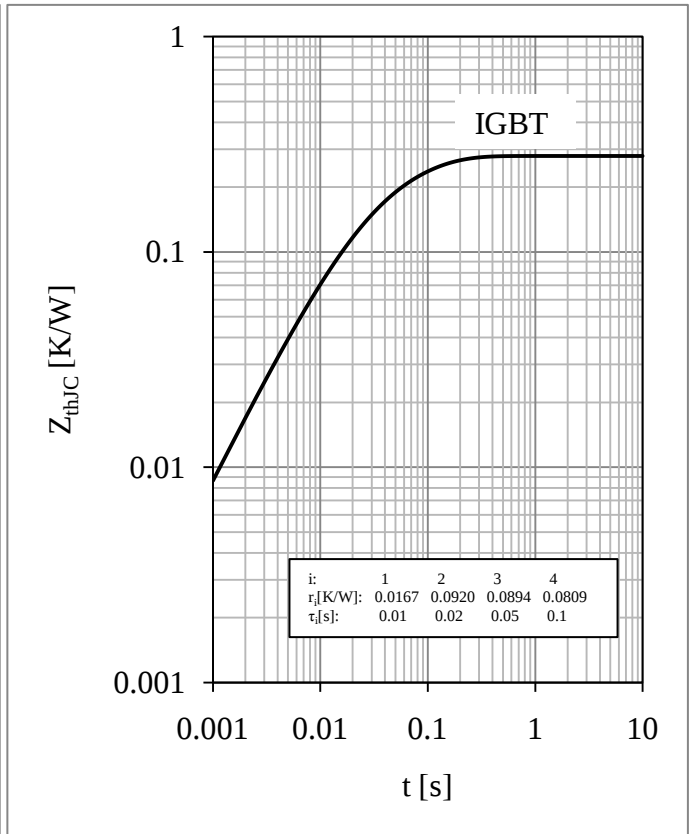


Fig 6. IGBT-inverter Transient Thermal Impedance

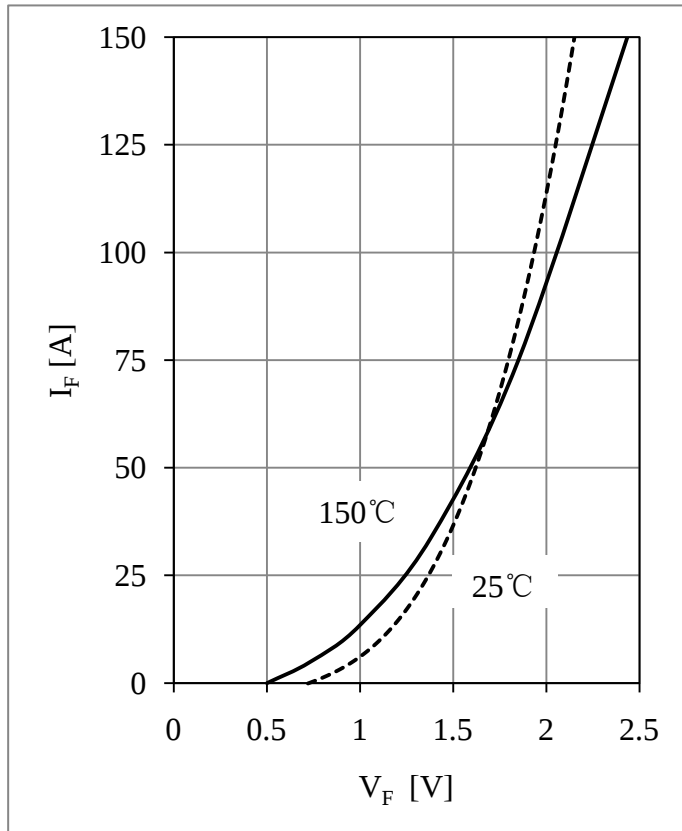
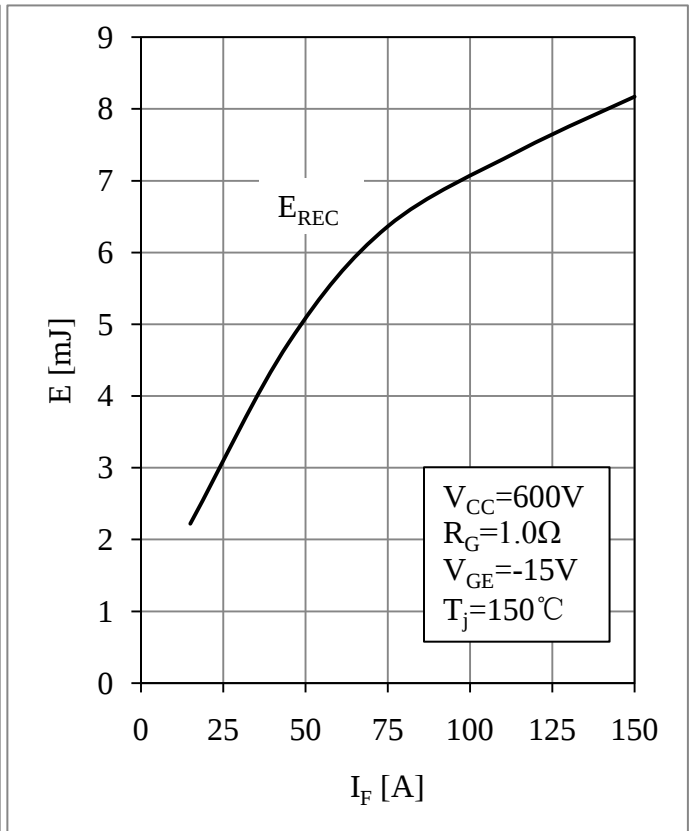


Fig 7. Diode-inverter Forward Characteristics

Fig 8. Diode-inverter Switching Loss vs. I_F

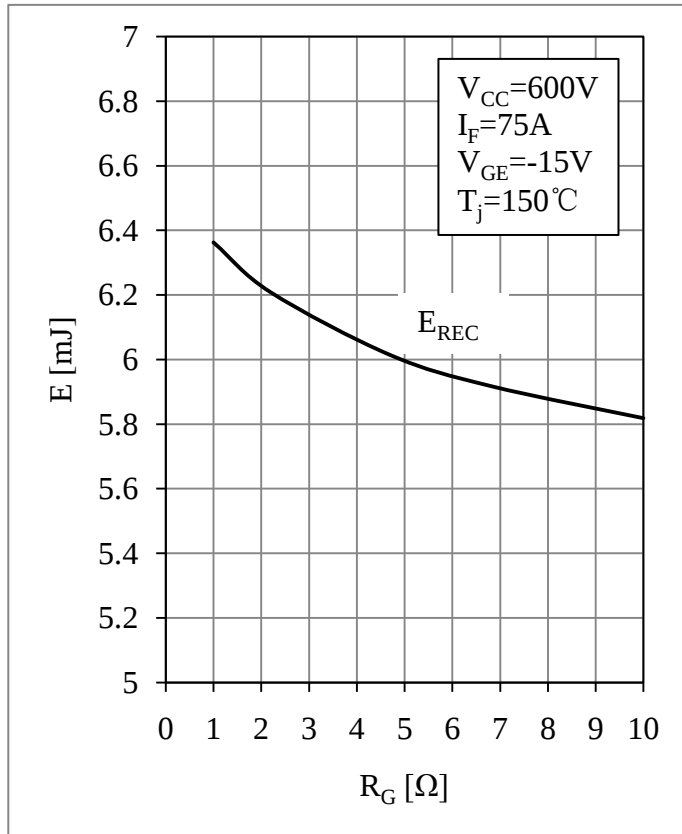
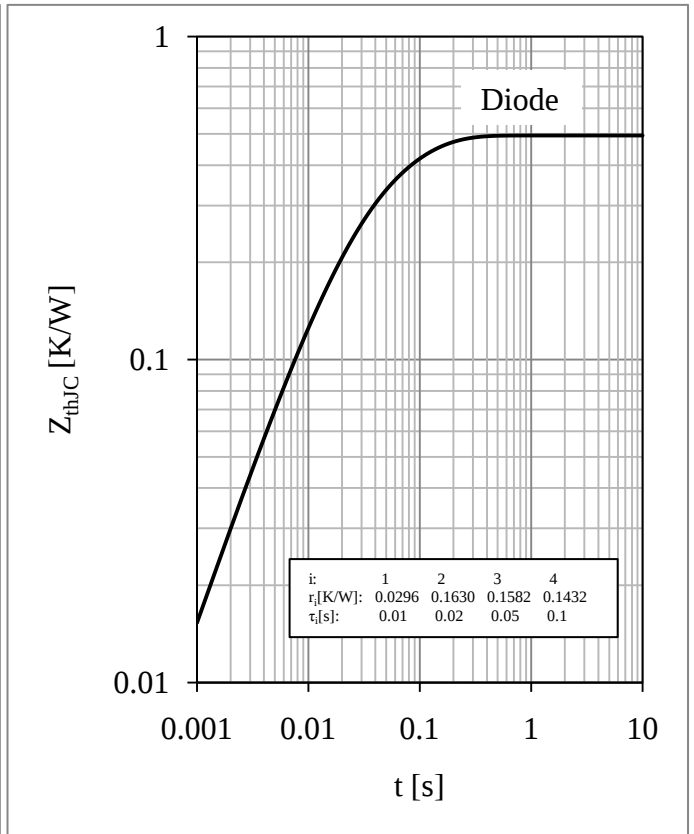
Fig 9. Diode-inverter Switching Loss vs. R_G 

Fig 10. Diode-inverter Transient Thermal Impedance

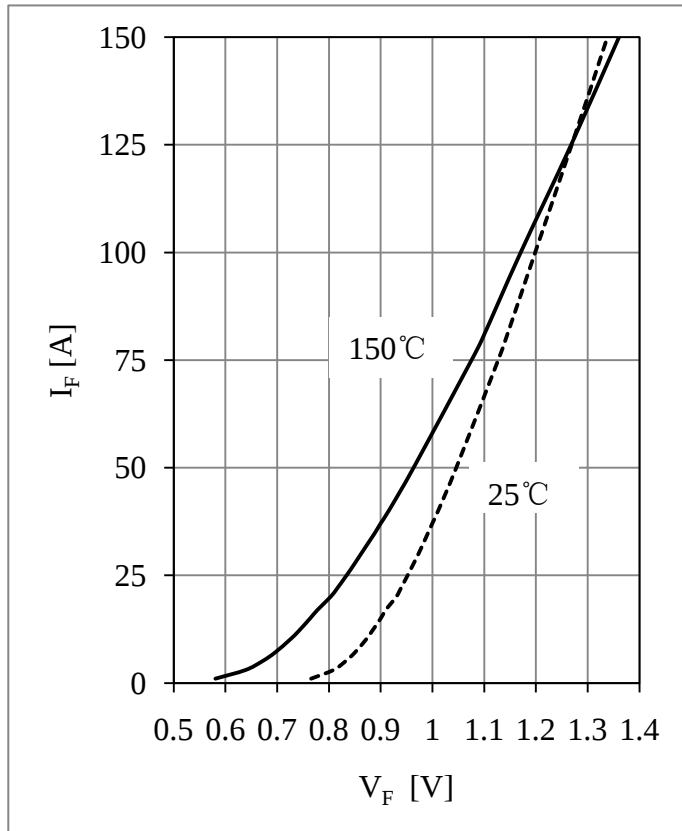


Fig 11. Diode-rectifier Forward Characteristics

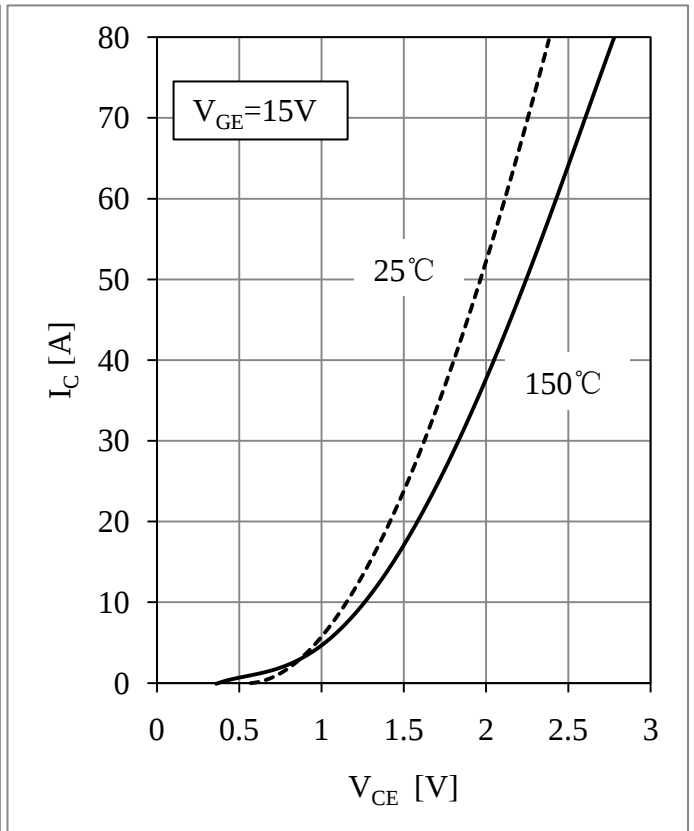


Fig 12. IGBT-brake-chopper Output Characteristics

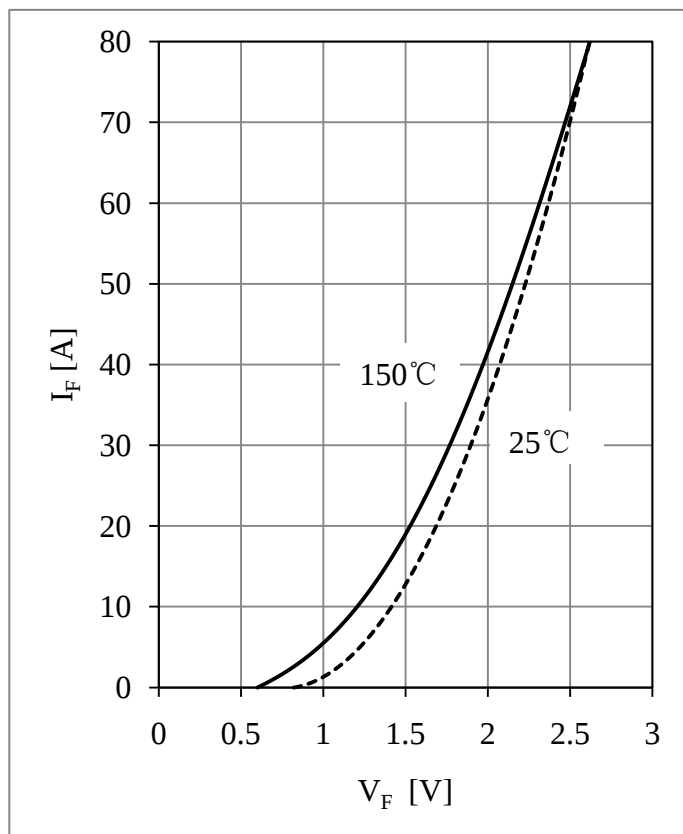


Fig 13. Diode-brake-chopper Forward Characteristics

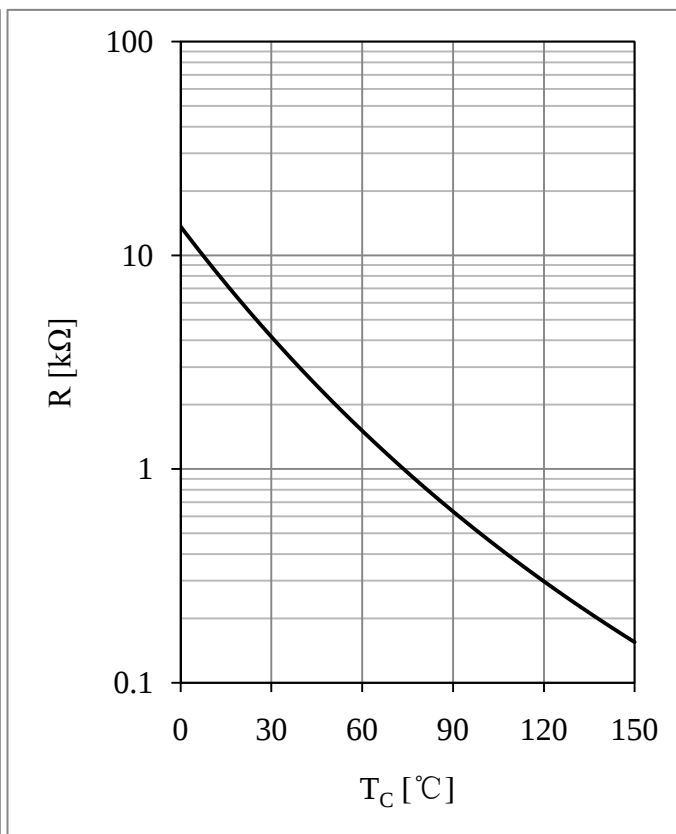
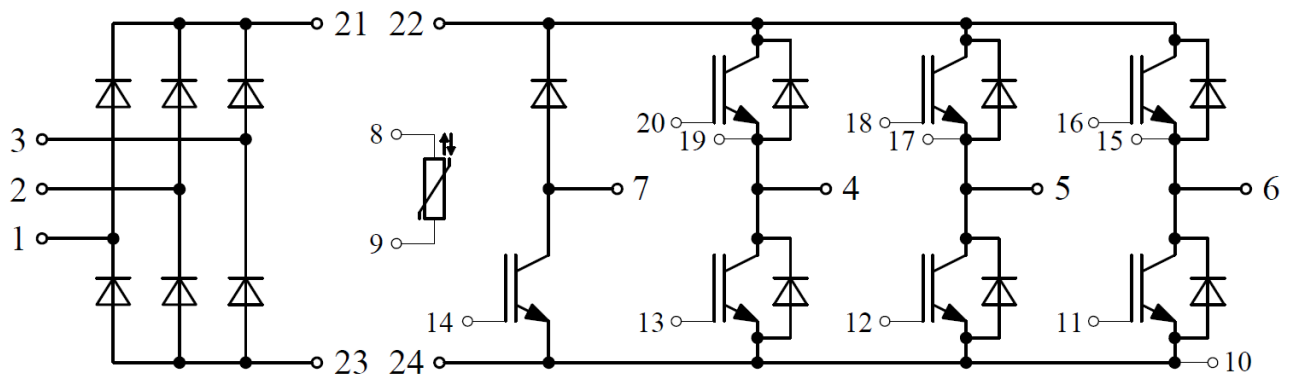


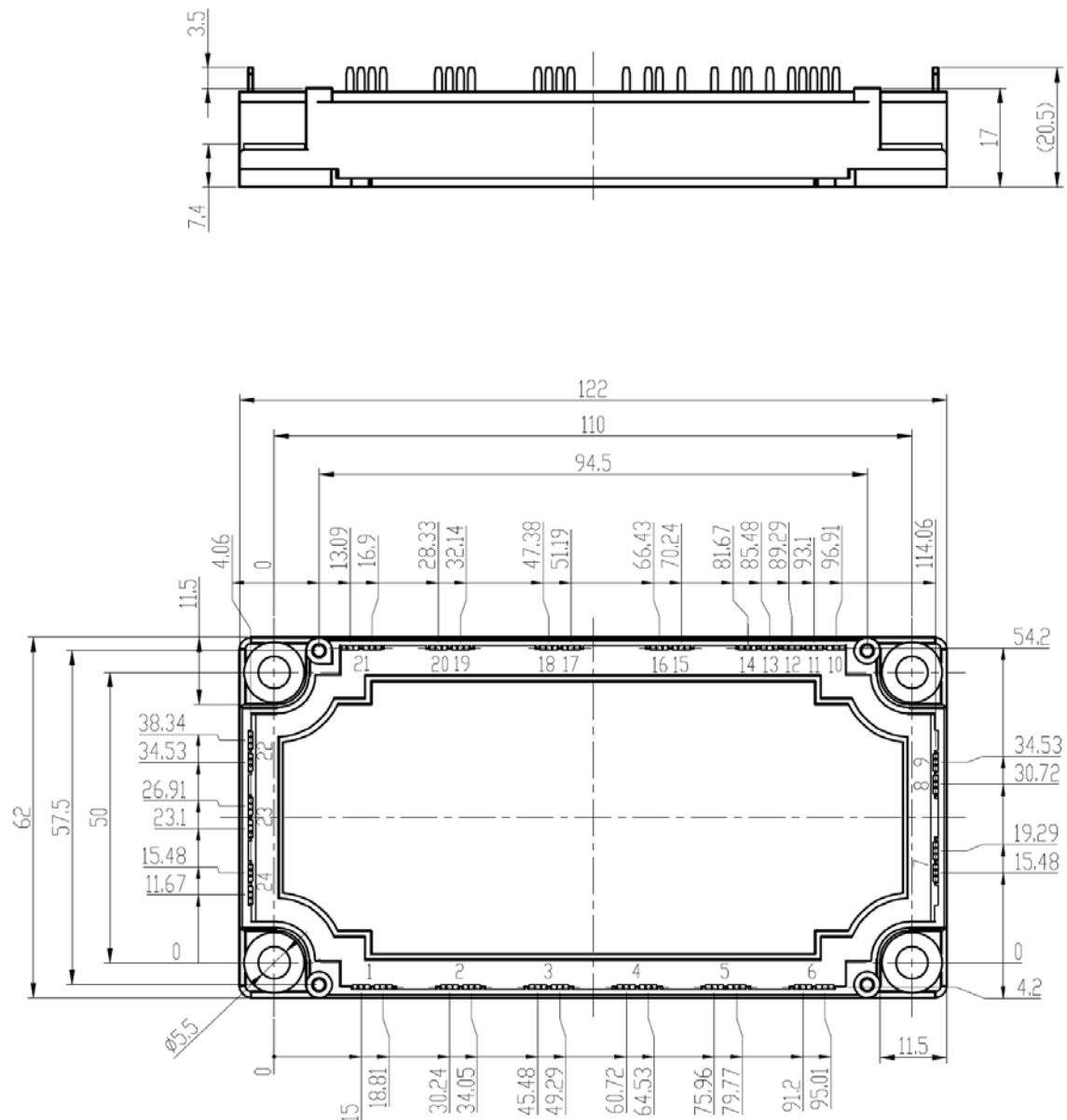
Fig 14. NTC Temperature Characteristic

Circuit Schematic



Package Dimensions

Dimensions in Millimeters



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